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REMARKS

This Amendment is being filed in response to the Office Action dated December 2, 2004. For the following reasons, this application should be considered in condition for allowance and the case passed to issue.

Claim 1 was objected to because of informalities. In particular, claim 1, line 5, uses the term "contact hold" instead of the correct term, "contact hole". The claims have been amended to reflect the correct term. Accordingly, withdrawal of the objection to claim 1 is respectfully requested.

Claims 1-9, 11 and 14-16 were rejected under 35 U.S.C. § 102(e) as being anticipated by Zhang et al. (hereafter Zhang). This rejection is hereby traversed and reconsideration and withdrawal thereof are respectfully requested. The following is a comparison of the present invention as claimed with the Zhang reference.

The present invention, as currently claimed in amended claim 1, relates to a method of forming a contact in a semiconductor device and comprises as the steps of forming a silicon substrate with a conductive region, and forming a dielectric layer on the silicon substrate and a contact hole in the dielectric layer exposing at least a portion of the conductive region. The refractory metal contact layer is deposited in the contact hole and on the conductive region portion. The silicide region is formed by reacting the refractory metal contact layer with the conductive region portion without exposure to plasma. A contact barrier metal layer is formed on one of the refractory metal contact layer or the silicide region. The contact barrier metal layer is plasma treated only after the forming of the silicide region.

The invention addresses and solves problems related to the formation of a contact in a semiconductor device, and particularly to problems arising from the plasma treatment provided to contact barrier metal layers and its effect on the contact metal underneath the barrier metal. This is

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achieved by the present invention, in part, by the formation of a silicide prior to the formation of the contact barrier metal layer. In certain embodiments, the contact barrier metal layer is formed on the contact metal, but the plasma treatment is not performed until after formation of the silicide. Hence, when the plasma treatment is performed on the contact barrier metal layer, as provided in the invention, the titanium silicide has already been formed. This prevents the titanium and the contact metal layer from being prematurely converted to titanium nitride to before being able to be converted to titanium silicide.

In order to anticipate claims of an invention, a single prior art reference must identically disclose each and every step of the claimed invention. It is respectfully submitted that Zhang fails to identically disclose each and every step in the method claims as amended. For example, claim 1 provides forming a silicide region by reacting a refractory metal contact layer with a conductive region portion without exposure to plasma. The contact barrier metal layer is plasma treated only after the forming of the silicide region. The advantages of such an arrangement are discussed above. However, Zhang fails to disclose such a step of forming a silicide region by reacting a refractory metal contact layer with a conductive region portion without exposure to plasma. In particular, Zhang states in paragraph 0036 "Alternatively, when the Ti layer is formed on a silicon substrate a layer of $TiSi_x$ may be formed during the first plasma treatment step." (emphasis added) Zhang also notes that the titanium silicide thickness varies as a function of the plasma treatment Ti as well as the plasma treatment temperature. By contrast, the present invention seeks to prevent exposure of the titanium or the silicide region to plasma, in order to prevent titanium from being prematurely converted to titanium nitride before being able to be converted to titanium silicide. Hence, Zhang actually teaches away from the present invention as currently claimed.

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Independent claim 15 contains similar limitations, including the formation of silicide at the contact region without exposure to plasma, and plasma treating the contact barrier metal layer after the formation of the silicide. Hence, claim 15 should also be considered allowable for at least the reasons advanced above.

Since claims 1-9, 11 and 14-16 are not identically disclosed by the Zhang reference, the rejection of these claims under 35 U.S.C. § 102(e) should be reconsidered and withdrawn, and such action is courteously solicited.

Claims 10, 12, 13, 17 and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Zhang and further in view of Huang. This rejection is hereby traversed and reconsideration and withdrawal thereof are respectfully requested.

Huang fails to overcome any of the deficiencies noted with respect to the Zhang reference. In particular, Huang performs a plasma treatment of the contact barrier metal layer prior to the formation of the silicide region, as discussed in paragraphs 28 and 29. The plasma treatment is carried out in order to remove impurities such as carbon, oxides which are inherently present in a first refractory metal nitride layer 112. A thermal-process is then carried out to trigger a reaction between the portion of the first refractory metal layer on the conductive region and the silicon atoms of the conductive region to form a metal silicide film. This is directly contrary to the claimed invention, as provided in claims 1, which required the plasma treating of the contact barrier metal layer only after the forming of the silicide region. Hence, either alone or in combination, the Huang and Zhang references do not show or suggest the invention as now claimed.

Since Zhang and Huang, in combination, do not show or suggest the invention as now claimed within the intent of 35 U.S.C. § 103, reconsideration and withdrawal of the rejection of the claims are respectfully requested.

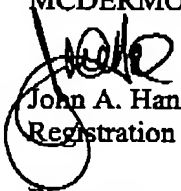
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In light of the amendments and remarks above, this application should be considered in condition for allowance and the case passed to issue. If there are any questions regarding this Amendment or the application in general, a telephone call to the undersigned would be appreciated to expedite the prosecution of the application.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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